

**Evaluating Management Methods for Five Non-Native Invasive Plant Species: Perennial Pepperweed (*Lepidium latifolium* L), Yellow Starthistle (*Centaurea solstitialis* L), Spotted Knapweed (*Centaurea maculosa*), Puncturevine (*Tribulus terrestris* L), and Dalmation Toadflax (*Linaria genistifolia* ssp. *dalmatica*)**



SIR Tribal Youth Conservation Crew (TYCC) hand pulling Yellow Starthistle, *Centaurea solstitialis* L.

**Conducted by**

**Susanville Indian Rancheria (SIR) Environmental Protection Department (EPD)**



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**Abstract:** During the 2003 and 2004 field seasons (May – October) the SIR EPD set up small plots (2-10 m<sup>2</sup>) on SIR tribal lands to analyze the effects of a variety of treatment techniques (chemical, physical, mechanical, and biological) singly and in combination on five non-native invasive plant species of concern: Perennial pepperweed (Tall Whitetop), *Lepidium latifolium* L; Yellow Starthistle, *Centaurea solstitialis* L; Spotted Knapweed, *Centaurea maculosa*; Puncturevine, *Tribulus terrestris* L; and Dalmation Toadflax, *Linaria genistifolia* ssp. *Dalmatica*. EPD staff collected pre-treatment data in May and June, including density (m<sup>2</sup>), percent cover (m<sup>2</sup>) of the invasive species of concern, and percent cover(m<sup>2</sup>) of desired species using a m<sup>2</sup> quadrat along a line transect that bisected the plots diagonally. Plots were then treated between June and September with a variety of techniques and post treatment data was collected in September and October.

Perennial pepperweed results indicate that when desired plants are present with >15% cover, mowing may inhibit their establishment as a competitor. When desired plant species are not present, mowing in combination with a herbicide application and subsequent seeding shows favorable results to reduce the percent cover of whitetop and establish a desired competitor. Six of the eight yellow starthistle plots and all of the punctervine plots established during the 2003 field season were heavily disturbed in October 2003 by construction activities on tribal lands before post treatment data could be collected. One of the two remaining 2003 yellow starthistle plots that received handpulling had a 100% removal of yellow starthistle when pre-treatment data was collected in 2004, but was replaced with punctervine in 2004 showing the importance of integrating a re-vegetation technique with a successful removal technique. Preliminary spotted knapweed results indicate that herbicide treatment at the rosette stage in combination with the planting of a native grass seed mix was the most effective treatment technique at reducing the percent cover of infestations. Cutting and bagging the flower tops and handpulling dalmation toadflax appear to be effective ways of treating dalmation toadflax populations. Additional data is needed for all plots before significant management decisions can be made with this data.

**Purpose/Introduction:** This study investigates and evaluates various management methods for noxious weed prevention and overall noxious weed population reduction. Five noxious weed species were included in this study. Some of the management methods used singly and in combination were: chemical, physical, mechanical, and

biological treatment methods. Single or combined treatment methods were applied to weed plots and evaluated for short-term results and where possible monitored for long-term outcomes. The SIR EPD strives to include the residents of the Rancheria in noxious weed eradication. Rancheria residents may potentially use the integrated pest management methods explored in this study to combat noxious weeds on a non-agricultural scale.

The five noxious weed species addressed in this study are present on SIR lands as well as in and around the City of Susanville and Lassen County. These aggressive weeds displace native plants, change plant community structure, degrade or eliminate habitat for native animals, reduce forage for livestock and wildlife, and are often considered pests by the general public. In 1998 the SIR joined forces with the Lassen County Interagency Special Weed Action Team (SWAT) in order to pursue noxious weed eradications on tribal lands. With the help of the SWAT group, which includes the Bureau of Land Management (BLM), the City of Susanville and Lassen County, the Natural Resource Conservation Service (NRCS), the UCCE, and the Lassen National Forest (LNF) among others, the Rancheria became involved in weed eradication efforts. In April 2003 the SIR EPD was awarded an EPA Tribal Non-Agricultural Integrated Pest Management (IPM) grant in order to develop an IPM program.



The first noxious weed included in this study is tall whitetop, or perennial pepperweed (*Lepidium latifolium* L). It is a member of the Mustard family and was introduced from southern Europe or western Asia. This weed is a deep-rooted perennial plant with an extensive, vigorous creeping root system which reproduces both vegetatively from the roots as well as by seed. It grows in waste areas, wet areas,

ditches, roadsides, cropland, along waterways, and dry habitats such as road cuts and fills (Renz, 2002). Individual white flowers are small and clustered at the ends of branched flower stalks. Tall whitetop plants are usually 2 to 6 feet high with a heavy, sometimes woody crown. The lower leaves are oblong with toothed margins. Tall whitetop plants out compete native vegetation and crops, often forming a monoculture. Attempts at mechanical removal, specifically tilling or disking, often spread root fragments that can result in a larger population. Parts of Lassen County, specifically the agricultural areas within Honey Lake Valley, have become heavily infested with tall whitetop over the past decade.



Yellow starthistle (*Centaurea solstitialis* L) is believed to be originally from Eurasia (Maddox, 1981). It is the most important roadside weed problem in much of central and northern California. This annual has caused problems in dryland cereals, orchards, vineyards, cultivated crops, and wastelands (Maddox et al. 1985). Human activities are the primary mechanism by which yellow starthistle



seeds are moved over long distances. Seed is transported in large amounts by road maintenance equipment and on the undercarriage of vehicles. The movement of contaminated hay and uncertified seed are also important long distance transportation



mechanisms. Once at a new location, seed is transported in lesser amounts and over short to medium distances by animals and humans. The short, stiff, pappus bristles are covered with microscopic, stiff, hair-like barbs that can adhere to clothing, hair and fur (Roché, 1992). Lassen County has made yellow starthistle prevention a priority due to neighboring counties having large, problematic populations.

Spotted knapweed (*Centaurea maculosa*) is an aggressive perennial species that rapidly invades pasture, rangeland and fallow land causing a serious decline in forage and crop production. It is believed that spotted knapweed was introduced from Eastern Europe into North America in the early 1900s as a contaminant in crop seed. A single plant can produce over 1000 seeds. The seeds can remain viable in the soil for

over 5 years and they can germinate in the spring through early fall in a wide range of soil depths, soil moisture contents and temperatures. Spotted knapweed can be identified from other *Centaurea* species by the pronounced black tip on the bracts of the seed head (Tulig, 2002). Spotted knapweed has few natural enemies and is consumed by livestock only when other vegetation is unavailable. Areas heavily infested with spotted knapweed often must be reseeded once the plant is controlled (Lym and Zollinger, 1992). Various



species of knapweeds have become problematic in Modoc County and in counties along the southern Oregon border.

Puncturevine (*Tribulus terrestris* L) is a warm season, mat-forming annual weed with an extensive root system. Leaves are finely divided into 4 to 8 pairs of leaflets, and stems and leaves are covered with hairs. The yellow flowers occur singly on the leaf axils and open only on sunny mornings, except in shady areas. The fruit consists of a cluster of 5 spiny nutlets or burrs that break apart at maturity (Donaldson and Rafferty,



NA). A native of Europe and Asia, puncturevine may have been introduced to the United States as a contaminant in the wool of sheep imported from the Mediterranean region. Also called goatshead, bullhead, or Mexican sandbur, this weed grows rapidly along roads and wasted places, leaving ample seed banks to ensure its spread. The large, spiny

seeds of this plant can cause injury to the mouths and digestive tracts of livestock and diminish the value of hay and wool.

Puncturevine can be a nuisance to recreationists, causing punctured bicycle tires and injuries to feet.

(Donaldson and Rafferty, NA)



Dalmatian toadflax (*Linaria genistifolia* ssp. *dalmatica*) is a member of the Figwort family. It was originally introduced as an

ornamental from Europe, and is now rapidly invading dry rangeland from 5,000 to 6,500 feet. Dalmatian toadflax is a creeping perennial that closely resembles yellow toadflax. The leaves are waxy, heart-shaped, and clasp the stem. The stems are from 2 to 4 feet tall. The flowers are snapdragon-shaped, bright yellow, and sometimes with orange centers. Dalmatian toadflax is especially well adapted to arid sites and can spread rapidly once

established. It has a deep, extensive root system and heavy seed production. These characteristics make this noxious weed difficult to manage. Fortunately, Lassen County does not have a serious dalmation toadflax problem, however, pockets of this species must be managed actively before the populations become too large (CWMA, 2000).

**Methods:** In May of 2003 SIR EPD began setting up study plots. Noxious weed plot sizes and locations were limited to available noxious weed populations on SIR lands. Due to the limited size and continuity of patches, buffer zones were unable to be created. Buffer zones are necessary in large, agricultural plot studies in order to minimize seed contamination and reduce the potential for seed or herbicide drift (Duncan, 2001). This study was on a smaller, non-agricultural scale and therefore single nozzle 3-gallon backpack sprayers were used for applying herbicides, weed wackers were used to mow plots, and a household seed spreader was used to disperse seed. The plots were not large enough to pose problems maintaining a consistent pattern of herbicide application throughout the plot. The small plot sizes were useful in being able to utilize labor-intensive management methods such as hand pulling or cutting the tops off of budding plants.

Plot locations for each weed species were chosen on the basis of plant density. The noxious weed populations on SIR lands are mainly small to medium sized patches. Measurements were taken to form rectangular or square plots for each noxious weed species. Larger weed patches were divided into smaller plot sections in order to test various treatment methods and to establish a control. As each plot was established the following data was collected: Length/width of plot or length of transect, name of data collector, date, time, general location, temperature, and cloud cover. A color photo was taken from an easily established photo point such as a mailbox or lamppost. When no such landmark was available a wood stake was used to mark the photo point. Each photo point was given a number. With the exception of puncturevine and dalmation toadflax plots, each plot would have a transect line stretched through it in order to conduct an accurate vegetation analysis. The small size of the puncturevine and dalmation toadflax patches allowed vegetative/cover data from each plot to be taken as a whole. Transect lines were stretched through larger plots, then measured and recorded. A meter-square  $\frac{1}{2}$ " PVC pipe quadrat was placed at random along each measured transect. The midpoint of the quadrat apparatus straddled the transect tape at the appropriate measuring point. The data recorded from each quadrat included the noxious weed(s) present, plant count, and ocular estimation of cover for the weed species and all other desired plant species combined. The data from each quadrat also included an ocular estimation of bare ground, rock, vegetative litter, and animal disturbance. Spotted knapweed plots were set up differently than the other species plots due to the density of plants. All plots were 35 m<sup>2</sup> and density and % cover were calculated for the total plot.

As each plot was established, data was collected using the transect/quadrant marker method. This information constituted pre-treatment data. The assessment data from each plot's three quadrats were recorded on an individual plot reference sheet. Each reference data sheet allowed for averaged pre-treatment data to be recorded along with 3-4 month post-treatment, 1-year post treatment data (or pre-treatment for the second year) and post

treatment (second year). Every reference data sheet had the date of the treatment data collected along with the plot photo date/number and the GPS date/file name. The date and time of different treatment types for each plot were recorded on reference data sheets as needed.

Herbicide application rates used were taken from each Material Safety Data Sheet and product labels. Rob Wilson, the weed ecology/farm advisor with the University of California Cooperative Extension, has also recommended herbicide/surfactant ratios and application rates for tall whitetop, spotted knapweed, and puncturevine. Product and company names are mentioned only for informational purposes and the SIR does not endorse those products over others not mentioned. The following specific herbicides were used in this study:

<u>Common Name</u>	<u>Product Name</u>
chlorsulfuron	Telar®DF
clopyralid	Transline™
2,4-D ester	Weedone LV6 or 2,4-D LV4®
2,4-D amine (riparian areas)	Weedar® 64
glyphosate	Roundup Glyphosate 50.2%

The following bio-control species were used in this study:

<u>Name</u>	<u>Source</u>
Yellow Starthistle Bud Weevil, <i>Eustenopus villosus</i>	Biological Control of Weeds, Inc. 1418 Maple Drive Bozeman, MT 59715
Knapweed Root Weevil, <i>Cyphocleonus achates</i>	(same as above)

105 knapweed root weevils were released onto the specified plot. 210 yellow starthistle bud weevils were released on both specified plots.

Treatment methods such as mowing and herbicide application were not repeated unless specified. Treatment methods were sometimes applied to more than one plot.

The treatment methods for tall whitetop plots were as follows:

- Control (No Treatment)
- Mowing, repeated at the flower bud stage
- Herbicide (Telar) at rosette - flower bud stage
- Herbicide (2,4 D-amine) at rosette-flower bud stage
- Mowing at the flower bud stage/herbicide (2,4 D amine) after the plants return to rosette-flower bud stage
- Mowing at the flower bud stage/herbicide (2,4-D ester) when plants return to the rosette-flower bud stage
- Mowing at the flower bud stage/herbicide (2,4 D-amine) when the plants return to the rosette-flower bud stage/Native Grass Seed (March, 2004)

- Mowing at the flower bud stage/herbicide (2,4 D ester) after plants return to the rosette-flower bud stage/Turf grass (March, 2004)

The treatment methods for yellow starthistle plots were as follows:

- Herbicide (Transline) when plants are bolting
- Turf grass seed 2004 only (not watered)
- Turf grass seed 2004 only (watered)
- Mowing when plants are bolting/Herbicide (Transline, 2004) when plants return to the bolting stage
- Bio-control (Hairy Bud Weevil) released in 2004
- Hand Pulling before flowering/Native Grass Seed 2004 Only

Similar yellow starthistle plots to those established in 2004 were developed in 2003 but were subsequently disturbed by construction activities occurring on SIR properties.

The treatment methods for spotted knapweed plots were as follows:

- Control
- Herbicide (Telar)
- Herbicide (Telar, 2003)/Native grass seed in March, 2004
- Bio-control released in September, 2003
- Native grass seed in March, 2004
- Herbicide (1<sup>st</sup>: Transline/2,4-D mix; 2<sup>nd</sup>: Transline only) in 2004 only
- Hand Pulling 2004 only/ Native Seed (Planned for October, 2004)

The treatment methods for dalmation toadflax plots were as follows:

- Control
- Flower tops cut and bagged
- Hand pulled
- Mowing in 2004 only
- Flower tops cut and bagged in 2004 only
- Mowing at bud stage in 2004 only

The treatment methods for puncturevine plots were as follows:

- Control
- Herbicide (Telar) in 2004 only
- Herbicide (Roundup) in 2004 only
- Handpulling
- Handpulling/turf grass (planned for October 2004)
- handpulling/native seed (planned for October 2004)

Similar punctervine plots were established in 2004, but were subsequently disturbed by construction activities taking place on SIR properties.



## Results:

**Table 1: WHITETOP PLOTS**

Plot Location	Method	Treatment Time	% Cover- weed	% Cover- native	Density (M <sup>2</sup> )
Spring #2 B	Control/	Pre-Treatment 2003	35%	0%	28
		Post-Treatment 2003	10%	0%	7
		Pre-Treatment 2004	18%	0%	9
		Post-Treatment 2004	6%	8%	16
Spring #2 C	Mowing	Pre-Treatment 2003	30%	0%	25
		Post-Treatment 2003	5%	0%	4
		Pre-Treatment 2004	23%	0%	13
		Post-Treatment 2004	4%	40%	6
Sweat Lodge Rd.	Herbicide (Telar)	Pre-Treatment 2003	76%	0%	35
		Post-Treatment 2003	0%	0%	0
		Pre-Treatment 2004	4%	0%	2
		Post-Treatment 2004	1%	0%	1
Spring #4	Herbicide (2,4 D-amine)	Pre-Treatment 2003	53%	27%	38
		Post-Treatment 2003	0%	0%	0
		Pre-Treatment 2004	30%	25%	21
		Post-Treatment 2004	0%	50%	0
Spring #2 A	Mowing/ Herbicide (2,4 D-amine)	Pre-Treatment 2003	40%	20%	25
		Post-Treatment 2003	8%	0%	5
		Pre-Treatment 2004	23%	43%	15
		Post-Treatment 2004	2%	3%	5
Spring #2 D	Mowing/ Herbicide (2,4 D-amine)/ Native Grass seed	Pre-Treatment 2003	40%	0%	30
		Post-Treatment 2003	7%	0%	6
		Pre-Treatment 2004	18%	0%	11
		Post-Treatment 2004	5%	15%	6
820 Joaquin St. front yard	Mowing/ Herbicide (2,4 D-ester)/ Turf Grass	Pre-Treatment 2003	84%	18%	22
		Post-Treatment 2003	0%	0%	0
		Pre-Treatment 2004	4%	38%	2
		Post-Treatment 2004	2%	8%	3
800 Joaquin St.	Mowing/ Herbicide (2,4 D-ester)	Pre-Treatment 2004	85%	5%	30
		Post-Treatment 2004	5%	5%	2
820 Joaquin St, back yard	Mowing/ Herbicide (2,4 D-ester)	Pre-Treatment 2004	75%	0%	33
		Post-Treatment 2004	3%	20%	2
Spring #1	Mowing	Pre-Treatment 2004	38%	3%	26
		Post-Treatment 2004	2%	23%	4

**Table 2: YELLOW STARTHISTLE PLOTS**

Plot Location	Method	Treatment Time	% Cover-Weeds	% Cover-Native	Density (M <sup>2</sup> )
Pump Station	Herbicide (Telar, 2003)	Pre-Treatment 2003	60%	0%	28
		Post-Treatment 2003	0%	0%	0
		Pre-Treatment 2004	0%	0%	0
		Post-Treatment 2004	0%	2%	0
NE of Head Start	Hand Pulling (periodic)	Pre-Treatment 2003	25%	0%	10
		Post-Treatment 2003	0%	0%	0
		Pre-Treatment 2004	2%	0%	1
		Post-Treatment 2004	0%	0%	0
Kei-Deh 479-650	Turf Grass/not watered	Pre-Treatment 2004	15%	30%	25
		Post-Treatment 2004	17%	3%	4
950 Joaquin St.	Turf Grass/ Handpulling /watered	Pre-Treatment 2004	0%	0%	0
		Post-Treatment 2004	5%	55%	1
710 Joaquin St.	Mowing/ Herbicide (Transline)	Pre-Treatment 2004	40%	0%	5
		Post-Treatment 2004	0%	5%	0
rear of clinic 2	Bio Control (Hairy Bud Weevil)	Pre-Treatment 2004	20%	27%	5
		Post-Treatment 2004	32%	15%	3
rear of clinic 3	Bio Control (Hairy Bud Weevil)	Pre-Treatment 2004	35%	58%	64
		Post-Treatment 2004	56%	34%	48
Springridnge Rd.	Handpulling (bolting)/ Native Grass (Oct. 2004)	Pre-Treatment 2004	30%	0%	28
		Post-Treatment 2004	0%	0%	0

**Table 3: PUNCTUREVINE**

Plot Location	Method	Treatment Time	% Cover-Weeds	% Cover-Native	Density (M <sup>2</sup> )
Tako-Nee 479-575	Telar	Pre-Treatment 2004	10%	10%	8
		Post-Treatment 2004	5%	10%	4
PV 3 Joaquin St.	control	Pre-Treatment 2004	40%	40%	22
		Post-Treatment 2004	50%	35%	20
PV 4 Joaquin St.	Roundup (Walmart) ?%	Pre-Treatment 2004	30%	40%	10
		Post-Treatment 2004	20%	30%	5
Between 3.21 and Head Start	Hand Pulling	Pre-Treatment 2004	90%	0%	8
		Post-Treatment 2004	0%	0%	0
E of Head Start	Hand Pulling Turf Grass	Pre-Treatment 2004	80%	0%	4
		Post-Treatment 2004	0%	0%	0
NE of Head Start	Hand Pulling Native Grass	Pre-Treatment 2003	0%	0%	0
		Post-Treatment 2003	0%	0%	0
		Pre-Treatment 2004	60%	0%	10
		Post-Treatment 2004	0%	0%	0

**Table 4: SPOTTED KNAPWEED PLOTS**

Plot Location	Method	Treatment Time	% Cover - Weed	% Cover- native	Density (35 M <sup>2</sup> )
Upper Rez C	Control	Pre-Treatment 2003	50%	0%	12
		Post Treatment 2003	0%	0%	0
		Pre-Treatment 2004	20%	0%	11
		Post-Treatment 2004	0%	40%	0
Upper Rez A1	Herbicide (Telar) -rosette	Pre-Treatment 2003	60%	0%	15
		Post-Treatment 2003	0%	0%	0
		Pre-Treatment 2004	10%	0%	3
		Post-Treatment 2004	0%	0%	0
Upper Rez E	Herbicide-Telar -bolting	Pre-Treatment 2003	40%	0%	11
		Post-Treatment 2003	0%	0%	0
		Pre-Treatment 2004	40%	5%	19
		Post-Treatment 2004	0%	25%	0
Upper Rez B	Bio Control (Knapweed Root Weevil)	Pre-Treatment 2003	60%	0%	14
		Post-Treatment 2003	0%	0%	0
		Pre-Treatment 2004	30%	0%	19
		Post-Treatment 2004	0%	10%	0
Upper Rez D	Native Grass	Pre-Treatment 2003	60%	0%	14
		Post-Treatment 2003	0%	0%	0
		Pre-Treatment 2004	20%	0%	5
		Post-Treatment 2004	0%	10%	0
Upper Rez A2	Herbicide (Telar, 2003)/ Native Grass (2004)	Pre-Treatment 2003	60%	0%	15
		Post-Treatment 2003	0%	0%	0
		Pre-Treatment 2004	5%	0%	1
		Post-Treatment 2004	0%	0%	0
Kei-Deh cul-de-sac	Herbicide (Trans/2,4 D)	Pre-Treatment 2004	47%	27%	9
	Herbicide (Transline)	Post-Treatment 2004	0%	0%	0
Tako-Nee	Handpulling/ Native Grass Seed	Pre-Treatment 2004	20%	50%	20
		Post-Treatment 2004	0%	50%	0

**Table 5: DALMATION TOADFLAX**

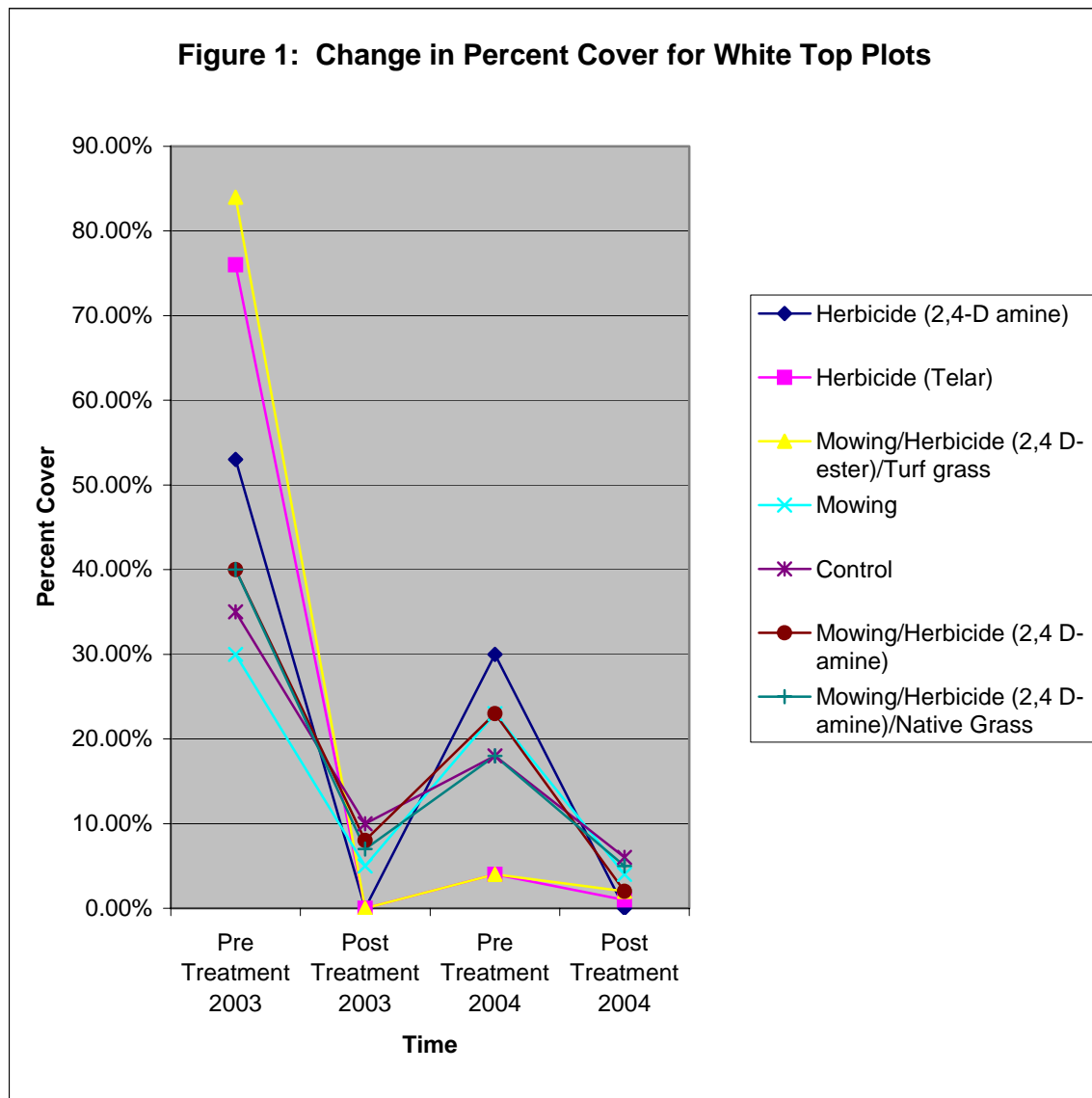
<b>Plot Location</b>	<b>Method</b>	<b>Treatment Time</b>	<b>% Cover-Weeds</b>	<b>% Cover-Native</b>	<b>Density (M<sup>2</sup>)</b>
Spring Ridge Rd. DT 01	cut tops and bagged	Pre-Treatment 2003	90%	5%	38
		Post-Treatment 2003	10%	5%	15
		Pre-Treatment 2004	1%	0%	1
		Post-Treatment 2004	10%	0%	12
Spring Ridge Rd. DT 02	control	Pre-Treatment 2003	95%	5%	65
		Post-Treatment 2003	97%	5%	98
		Pre-Treatment 2004	95%	0%	110
		Post-Treatment 2004	98%	0%	118
Spring Ridge Rd. DT 03	handpulled	Pre-Treatment 2003	50%	25%	24
		Post-Treatment 2003	10%	25%	5
		Pre-Treatment 2004	40%	0%	24
		Post-Treatment 2004	10%	0%	7
Spring Ridge Rd. DT 04	mowed 1x	Pre-Treatment 2004	40%	30%	46
		Post-Treatment 2004	10%	30%	12
Spring #2 DT 05	cut tops and bagged/ Native Grass	Pre-Treatment 2004	90%	5%	120
		Post-Treatment 2004	90%	5%	126
Spring #2 DT 06	mowing 1x bud stage	Pre-Treatment 2004	85%	10%	85
		Post-Treatment 2004	70%	10%	42



## Discussion:

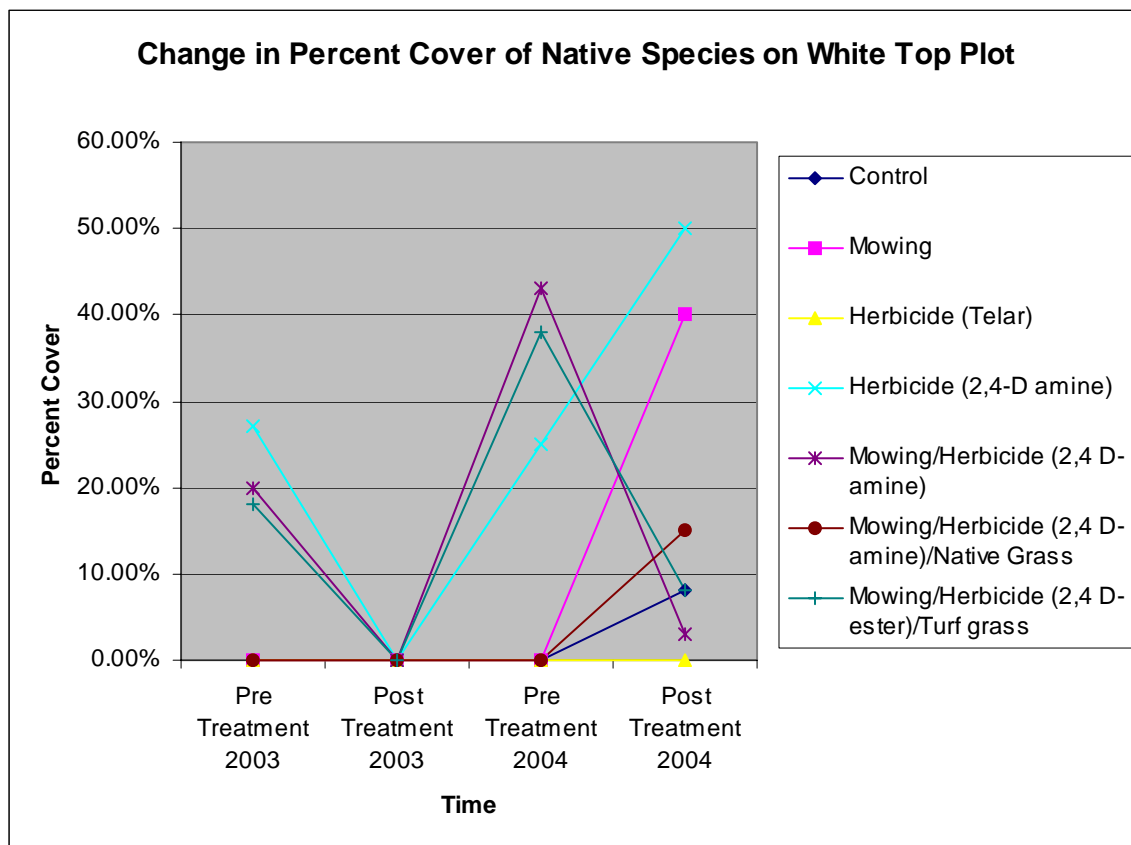
### Tall Whitetop

All of the 2003-2004 tall whitetop plots showed decreases in percent cover. The plots varied in location, with three test areas located on Upper Rancheria lands (875 acres) near springs and the rest in the residential lower Rancheria. Differences between plots in terms of overall plant health can be attributed to differences in slope, soil type, and elevation. The control plot at Spring 2 (upper Rancheria 875 acres) showed a plant density of 16 (8/2004) but a percent cover of only 6.00%. In contrast, the 800 Joaquin Street plot (lower Rancheria) showed a plant density of 2 but a percent cover of 5.00% (8/2004) (*See Table 1*). Generally the whitetop re-growth after treatment(s) was healthier on the lower residential areas than on the upper 875 acres.



Rob Wilson of the UCCE found in his tall whitetop plot studies that herbicide treatments applied at the flower-bud stage provided the best overall whitetop control. Herbicide application at the rosette stage proved to be less effective. All of the Rancheria's plots that underwent mowing and herbicide treatments were mowed first in late May/early June with a weed whacker. The mowing prevented early flowering, however, the majority of re-growth plants that were later sprayed with 2,4-D were in the rosette stage. The plant growth stage at the time of herbicide application did not overtly influence control rates since the percent cover decreased consistently as seen in the Spring 2 plots.

In 2003 there was unforeseen horse damage that occurred within Spring 2 and Sweat Lodge Road plots. The free-range horses were attracted to water in the Spring 2 area and hay that was placed near the Sweat Lodge Road plot. Plants within the plots were trampled and the earth became firmly packed.

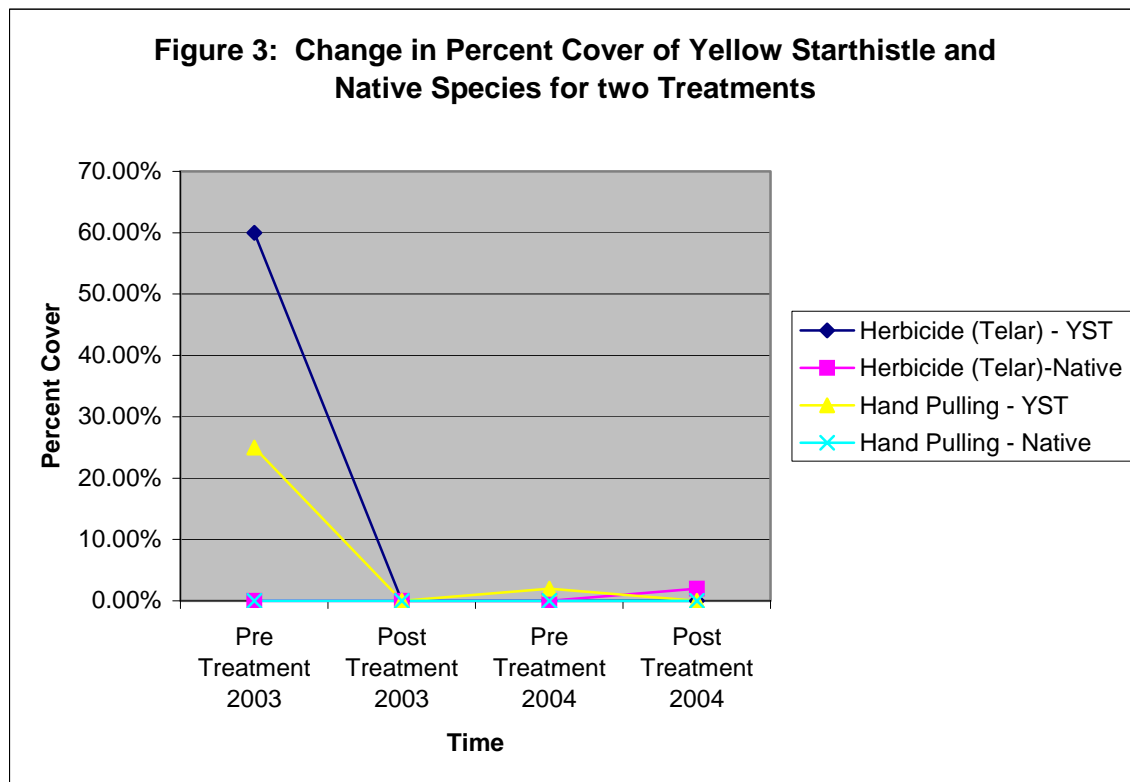


All plots that had native species present in 2003 showed an increase in the percent cover of desired native species between pre-treatment 2003 and pre-treatment 2004 (See Figure 2). Results seem to indicate that when native species are present pre-treatment (<15%) mowing may inhibit native plants as well as the weed species being treated as indicated by dramatic declines in percent cover in three of the mowed plots from pre treatment 2004 to post-treatment 2004 and a dramatic increase in the plot at Spring #4 that was only treated with Herbicide (Telar). Results indicate that mowing may be advantageous when there are no native plants present pre-treatment and a seed mix is added as indicated by

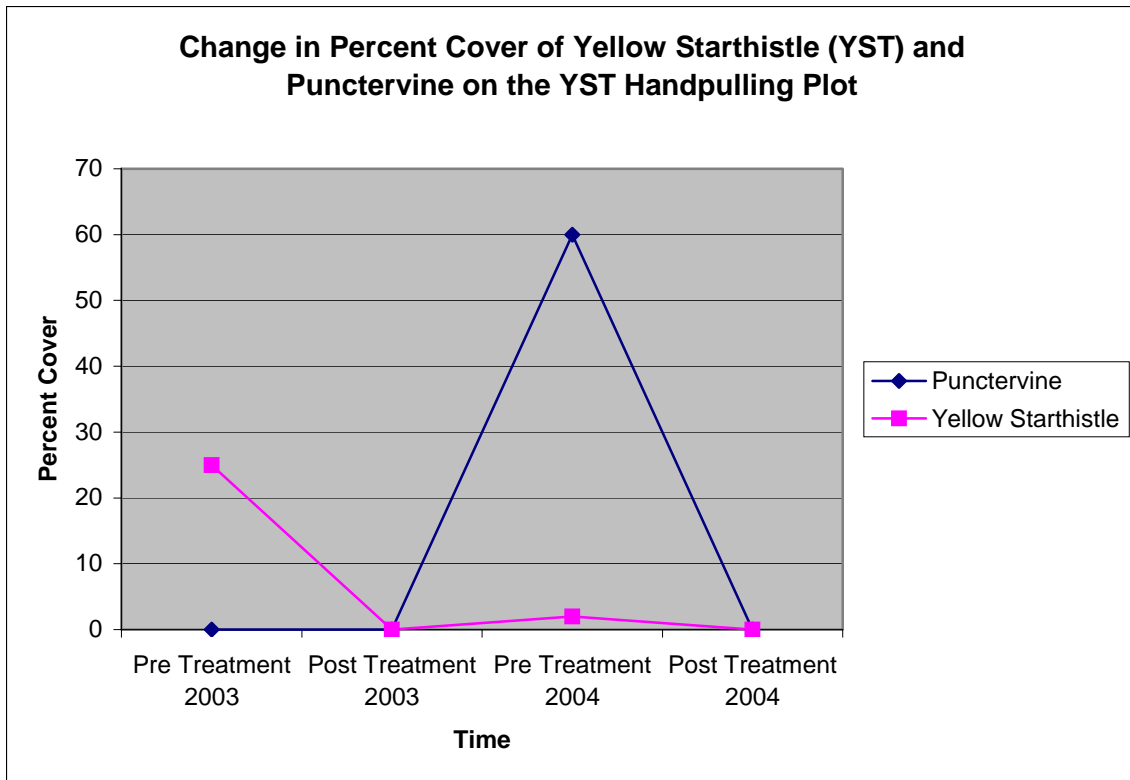
the plot that was treated with native grass seed in March of 2004. Plots will be established next year to investigate these trends further as well as a plot to investigate a new technique, solarization/native seed, which will involve placing clear plastic over the weed area for a couple months in order to sterilize the seed bank and then seeding the area with native grass seed to establish a competitor in the area.

### Yellow Starthistle:

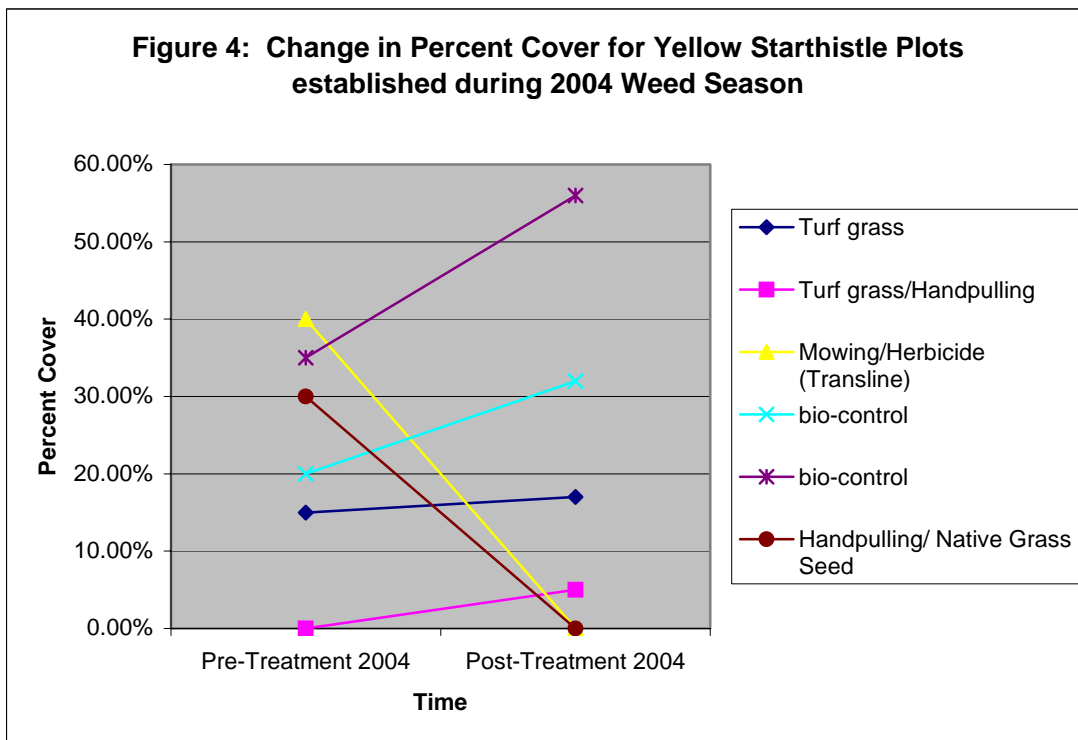
Of the eight plots that were established during the 2003 weed season, six of them were disturbed by construction activities before post treatment data could be collected in 2003. Results from the two surviving plots indicate that both treatment techniques, herbicide (Telar) and periodic handpulling, resulted in dramatic declines in density and percent cover, although native plant species were not established to outcompete future infestations (*See Figure 3*).



The problems this can create are illustrated in the starthistle hand-pulling plot where yellow starthistle was removed and replaced with punctervine (*See Figure 4*).

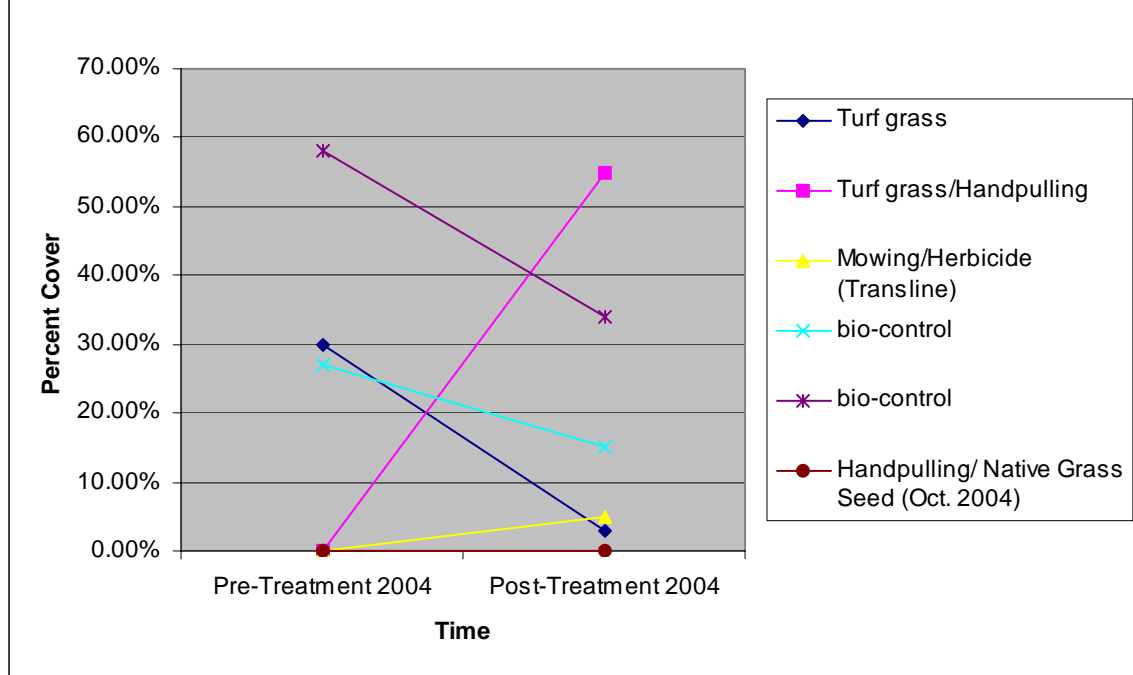


Data from the plots established in 2004 is inconclusive at this time and another season of data will be needed before any conclusions can be drawn (See Figure 4).





**Figure 5: Change in Percent Cover of Desired Species in Yellow Starthistle Plots established in 2004**



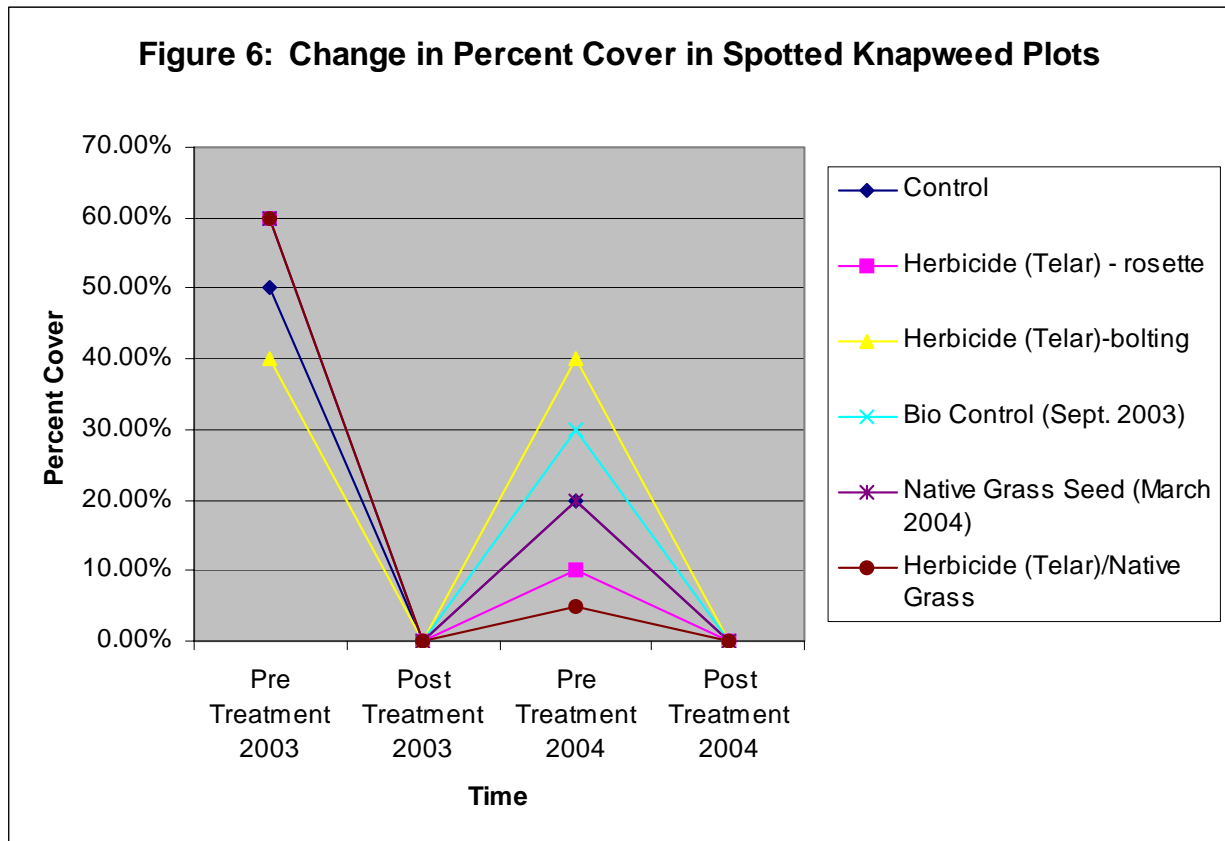
A combination of herbicide application and mowing with a weed whacker at appropriate intervals can reduce plant cover and resulting seed load. The two plots that were seeded with turf grass seed showed different results. Both plots were in residential yards. The owner watered the turf grass plot where yellow starthistle was also handpulled and the other plot was not. The turf grass plot that received water did not have any starthistle when pre-treatment data was collected although star thistle was documented in this area during the 2003 weed season. The un-watered seeded plot showed little competing grass growth (3.00% other vegetative cover in 8/2004). The watered seeded plot produced 55.00% of other vegetative cover. Even with grass competition yellow starthistle emerged within the watered seeded plot and resulted in 5.00% cover at the time of post-data collection (8/12/04). Handpulling did not remove all plants in this area because this would have damaged the emerging lawn. Two plots had a bio-control agent released in order to reduce seed production. The Yellow Starthistle Hairy Weevil, *Eustenopus villosus* was released at the base of plants in June 2004. Larval feeding on the plants' receptacle tissues can reduce seed production by 80%. Both bio-control plots showed an increase in percent cover of yellow starthistle, however, the weevil may have reduced the number of viable seed heads. Since yellow starthistle reproduces only by seed, the Hairy Weevil should have an impact on population over the course of 2-3 years

A control plot was not established this year and will need to be designated next field season in order to better interpret results. In addition, the handpulling plot NE of the SIR Headstart building, where starthistle was reduced dramatically and punctervine took its place, will be divided into two plots: one half will be solarized and then receive native seed and the other will receive native seed only in order to evaluate how best to introduce

desired plant species to disturbed, infested areas. Both plots will still receive handpulling treatments.

### Spotted Knapweed

Spotted knapweed studies indicate that control of spotted knapweed is greatest when herbicides are applied in the fall or early spring when plants are still in the rosette stage. Annual spraying and monitoring over a period of several years is necessary for seedling control (Lym, 2004). Similar results were seen in this study (*See Figure 6*).



Residents of the Upper Rancheria complained in 2003 that an application of herbicide to spotted knapweed during the bolting stage seemed to fertilize the plants rather than kill them. This is supported by the results of this study where the percent cover in the control plot actually decreased more than the plot with the herbicide application during the bolting stage. A couple more years of data will be needed before the effects of seeding and bio control can be fully evaluated.

Two new plots were established during the 2004 field season. One plot was developed to investigate the effectiveness of the herbicide, Transline, and the other was established to investigate the effectiveness of late season handpulling, when plants are going to flower.

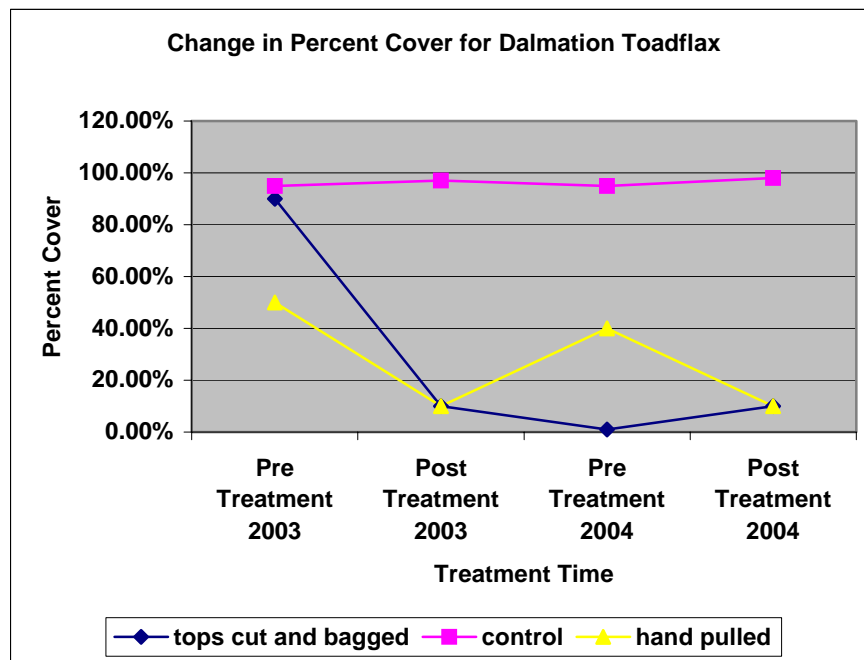
The Modoc UCCE, which has been doing extensive research on Spotted Knapweed, recommended both of these treatments.

In the spotted knapweed 2003-2004 plots the bio-control released in early September of 2003 was the Knapweed Root Weevil *Cyphocleonus achates*. Evidence of the Knapweed Root Weevil was found in September 2004 as the larvae that feed on the taproot hatch into adult stage in early fall.

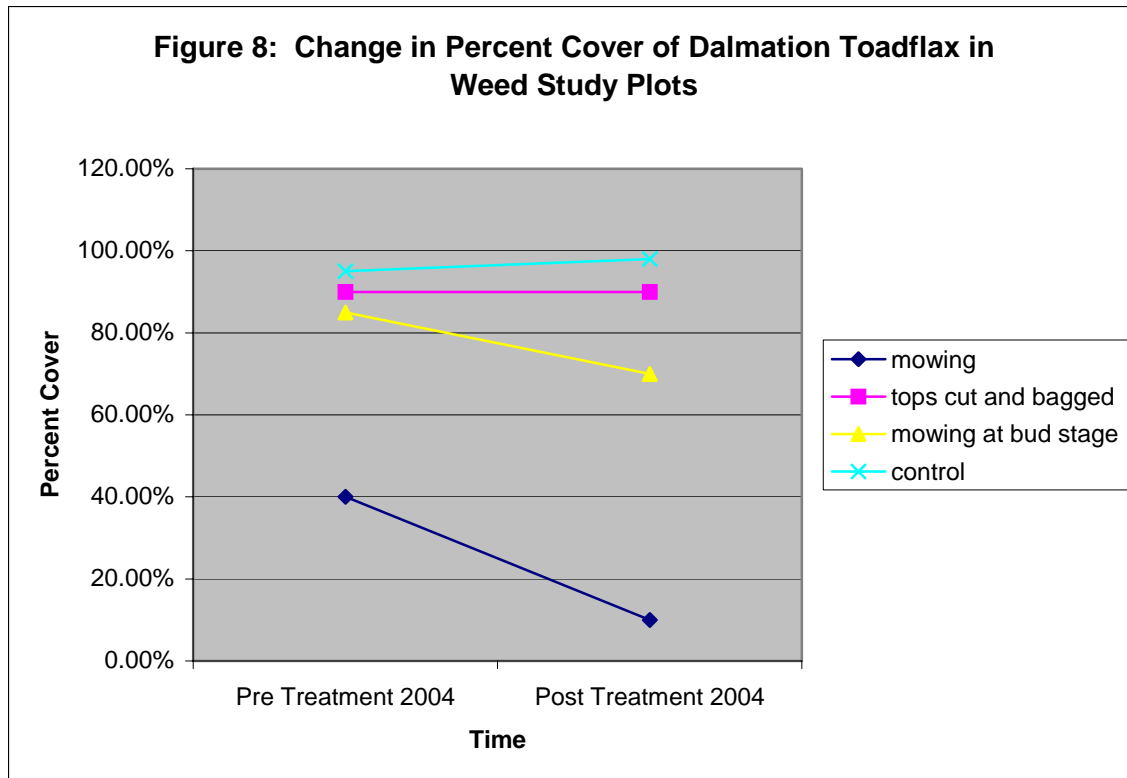
Results from the 2003-2004 spotted knapweed plots were similar and showed that long-term monitoring and treatments would most likely have to occur in order to plot significant changes. Emphasis should be placed on prevention of seed load buildup by timing treatment methods. If treatment methods such as herbicide application and mowing are not applied before the plants have flowered, hand-pulling is often the only way of avoiding seed dispersal.

### Dalmation Toadflax:

Results from the 2003-2004 dalmation toadflax plots indicated that cutting the flowering heads off of dalmation toad flax plants and hand pulling dalmation toadflax were both effective ways of reducing the population size of infestations (See Figure 7).



In 2004, three additional plots were established to investigate the effects of mowing on dalmation toad flax and an additional cut and bag plot was established in order to corroborate results from the 2003 cut and bag plot (See Figure 8). Further data needs to be collected in future field seasons in order to interpret the current results.



#### **Puncturevine Discussion:**

Six plots were set up in 2003 but were disturbed by construction prior to post-treatment data being collected. Six additional plots were established in 2004. Results are inclusive until future data is collected. Two of the 2004 plots (control and Roundup) were partially disturbed by construction vehicles but not enough to abandon the results. Telar and Roundup (50.2%) were applied to two separate plots, one plot was kept as a control, and three hand-pulling plots were established. One of these will be divided in half and receive turf grass before the first big snow and then again in March, the other will receive solarization treatment from May to June of 2005 and then be seeded with turf grass and watered. Another hand pull plot will be divided, but instead of turf grass it will receive native grass, and the third hand pull plot will not receive seed.



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